

- 18 A method as in Claim 16, wherein  $D=(1-z^{-1})/T_s \cdot I$ , where  $I$  is the identity matrix of order  $n$ ,  $E=K_1$ ,  $C=K_1$  or  $C=K_1+K_2D$  or  $C=K_1+K_2D+K_3D^2$  or  $C=K_1+K_2D+K_3D^2+K_4D^3$  or  $C=K_1+K_2D+K_3D^2+K_4D^3+\dots+K_mD^{m-1}$ , where  $m$  is a positive integer, and the coefficients  $K_1, K_2, \dots, K_m$  are  $n$  by  $n$  constant matrices and are the said tuning parameters.
- 19 A method as in Claim 17, wherein  $D=(1-z^{-1})/T_s \cdot I$ , where  $I$  is the identity matrix of order  $n$ ,  $E=K_1$ ,  $C=K_1$  or  $C=K_1+K_2D$  or  $C=K_1+K_2D+K_3D^2$  or  $C=K_1+K_2D+K_3D^2+K_4D^3$  or  $C=K_1+K_2D+K_3D^2+K_4D^3+\dots+K_mD^{m-1}$ , where  $m$  is a positive integer, and the coefficients  $K_1, K_2, \dots, K_m$  are  $n$  by  $n$  constant matrices and are the said tuning parameters.
- 20 A linear controller as in Claim 16 with its structure and tuning parameter determined by Claim 18 and  $m>3$ .
- 21 A linear controller as in Claim 16 with its structure and tuning parameter determined by Claim 19 and  $m>3$ .

### **In Abstract**

Please cancel the old abstract and substitute the new abstract as follows:

-- Methods of designing optimal discrete time linear controllers are disclosed. The optimal values of the tuning parameters in a linear controller can be found by minimizing the maximum of absolute values of all poles of the discrete time closed-loop transfer function from the set point to the process variable. This is a minimax problem and can be solved without any difficulty. A constrained optimization can be used to solve this minimax problem in cases where one or more of the tuning parameters are subject to lower limit and/or upper limit constraints. The PID (proportional-integral-derivative) controller tuning problem is thus solved since PID controllers can be considered as special cases of the general linear controller.--